THE KAIDUN METEORITE: MINERALOGY OF A Ca-RICH ROCK FRAGMENT

L.F.Migdisova[1], A.V.Ivanov[1], F.Brandstaetter[2], G.Kurat[2], and N.N.Kononkova[1]; [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, Kosygin str. 19, Moscow 117975, Russia, [2]Naturhistorisches Museum, Postfach 417, A-1014 Vienna, Austria.

Introduction: Kaidun is an extremely heterogeneous breccia. It is the only meteorite known that contains carbonaceous, enstatite, and ordinary chondrite clasts [1, 2]. In addition, the carbonaceous and enstatite chondrite lithologies are represented by fragments of different chemical and mineralogical groups. Here we present the results of our SEM and EMP studies of fragment #58.08, that is different from other Kaidun fragments studied previously.

Petrography: A polished section of the rock fragment (Fig. 1) measuring 1.8 x 1.3 mm2 was investigated. The rock is coarse-grained with an igneous, ophitic texture. It consists of 97 vol.% silicates and ~3 vol.% opaque phases. Grain-sizes of the silicates vary from 50-80 to 200-300 µm. The distribution of minerals in the section is irregular which results in a taxite-like character of the texture. The opaques are present mainly in thin veins within and in between the silicates .

Mineral chemistry: The composition of silicates is uniform: Ca-rich pyroxene En55Wo42Fs3, orthopyroxene En91Wo3.5Fs5.5, olivine Fo94.5, plagioclase An29.5Ab69.3Or1.2. The metal composition is rather variable: Ni 7-12, Co 0.7-1, P 0.6-1, Si <0.1 wt.%. The Ni/Co ratio is non-chondritic and usually <15. Troilite contains 0.6 wt% Cr and <0.05 wt.% Ti. According to the two-pyroxene geothermometer of [3] the temperature of equilibration of the rock is about 1000-1100 °C.

Bulk composition: The bulk modal composition (vol.%) of the fragment as determined by point counting is: Ca-rich pyroxene (diopside) 32.2, orthopyroxene (enstatite) 30.9, olivine 21.4, plagioclase 10.5, Si- and K-rich glass 1.9, Fe,Ni-metal 2.3, and troilite 0.8.

The bulk chemical composition (wt.%) of the fragment is SiO_2 50.5, TiO_2 0.24, Al_2O_3 2.9, Cr_2O_3 0.52, FeO 2.7, MnO 0.33, MgO 27.3, CaO 7.8, Na_2O 1.0, K_2O 0.02, Fe_{met} 5.6, Ni_{met} 0.6, Co_{met} 0.01, P_{met} 0.04, S 0.38.

Discussion: The composition of orthopyroxene and olivine of the rock fragment is Fe-poor and close to that of silicates in enstatite meteorites, indicating a reducing environment during formation. However, the very high content of diopside and the correspondingly high content of calcium of the bulk rock distinguishes this rock from the known enstatite meteorites.

The only meteoritic objects with chemical compositions similar to that of the Kaidun rock fragment are rare chondrules and clasts that were found in some ordinary and carbonaceous chondrites [4-7] (Fig. 2). The mineral composition of some of these chondrules and clasts [6] is similar to that of the minerals of our rock fragment, but the silicates are usually Fe-rich. Also, the texture of the objects is commonly fine-grained, indicating faster cooling as compared to the Kaidun fragment. We did not find in the literature any report on the presence of such objects in enstatite chondrites.

The formation of such a Ca-rich rock is difficult to model by a "magmatic" type differentiation process of chondritic material. However, fragment #58.08 differs markedly from any stony meteorite component in terms of mineralogical and chemical composition. Thus, we cannot exclude that the studied and other similar fragments represent a new type of Ca-rich chondritic material which was not found up to-date as an individual meteorite.

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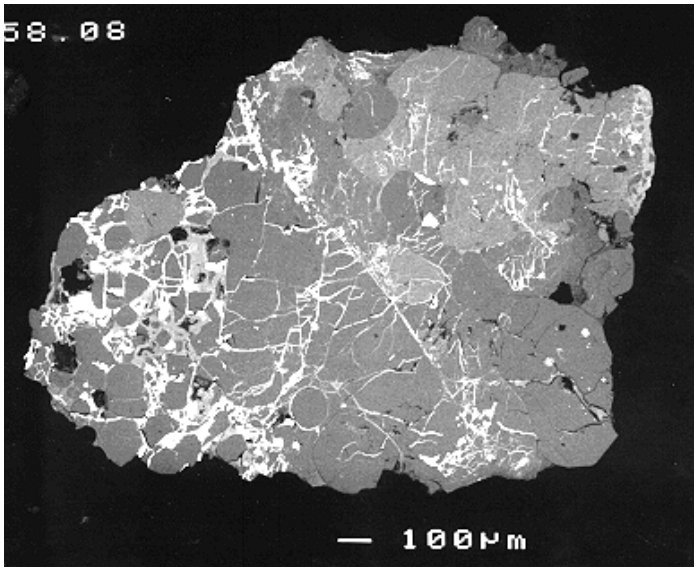

Figure 1: Rock fragment # 58.08 exhibiting an igneous, ophitic texture. Opaques (white) occur mainly in thin veins within and around silicate grains (dark grey to medium grey).

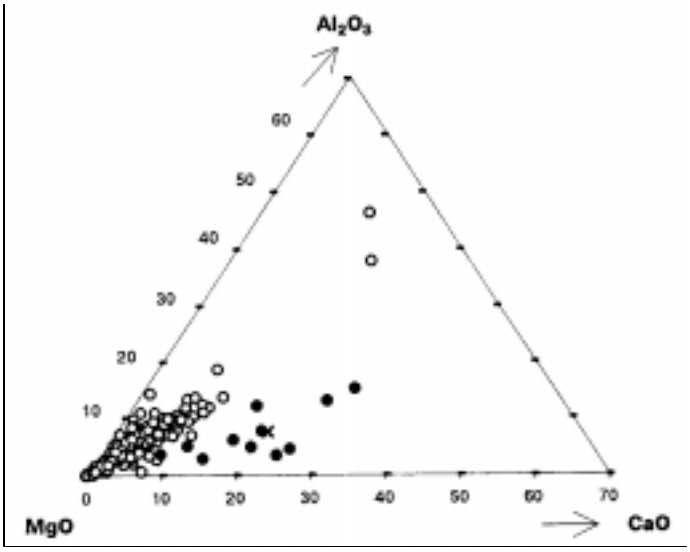

Figure 2 : Al_2O_3-MgO-CaO wt.% diagram for some chondrules and fragments. Open circles: chondrules from Y-691 EH3 chondrite [8], closed circles: Ca-rich chondrules and fragments from O an C chondrites [4-7], cross: Ca-rich fragment [this work].